

Forest Floor Consumption and Smoke Characterization in the Boreal Forest of Alaska—Update 2003

By

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Summary

The Joint Fire Science program funded a 3-year study to measure and model the forest floor consumption and sample flaming and smoldering emissions during wildfire and prescribed fires in the boreal forests of Alaska. During the summer of 2003, fuel consumption was measured at 5 sites on the Erickson Creek Fire (B-299) along the Dalton Highway, at one site on the Black Hills wildfires near Tok, and at one site on the Chena Lakes (F-unit) prescribed fire near Fairbanks. Smoldering smoke emissions were measured at two sites on the Erickson Creek (B299) wildfire and on one site on the Chena Lakes prescribed burn. In addition, several hundred forest floor “moss and duff plugs” were collected and transported to the Missoula Fire Lab and will be burned and emissions sampled under various moisture and frozen layer conditions.

Introduction

Many areas of the boreal forest of Alaska contain deep layers of moss, duff, and peat, resulting in a large pool of biomass that potentially can burn and smolder for long periods of time creating hazardous smoke episodes for local residents and communities and causing detrimental landscape impacts. Research to quantify fuel consumption, flammability thresholds, and smoke production in boreal forest types is critical for effective modeling of fire effects (e.g. smoke emissions, regional haze, permafrost melting, erosion, plant succession, etc) and landscape management if prescribed burning is to become an important fuels treatment method in the future. Preliminary research has generated a hypothesis of the controlling variables that govern the fuel consumption in the moss and duff layers, but this hypothesis needs to be verified and tested through field-based experimentation. Very limited smoke emissions characterization has been completed. Consequently, the Joint Fire Science Program funded this study to collect fuel consumption data and characterize smoke emissions on active wildfires and prescribed fires. The data will be used to develop new and modify existing forest floor fuel consumption models and develop emission rate equations for the boreal forest fuelbed type.

Accomplishments

During June, 2003, the Fire and Environmental Research Applications Group (FERA) and the Missoula Fire Chemistry project sent scientists and technicians to Fairbanks to collect forest floor plugs, establish forest floor consumption plots on the Erickson Creek (B299) fire, and measure smoldering emissions. Several hundred moss plugs were collected during this period and transported to Missoula, Montana. The Erickson Creek wildfire started during this time and allowed us to begin sampling forest floor consumption and smoldering emissions. Between 9 and 18 forest floor consumption plots were established on 5 different sites within the wildfire perimeter. Sixteen forest floor consumption pins were positioned in a "X" configuration around each plot center. Ten fuel moisture samples were collected for each of the live moss, dead moss, upper duff and lower duff layers at each site. The areas were then hand ignited or the wildfire was allowed to burn across the area. Following the fire, each area was re-entered and the amount of forest floor consumption was measured and in some instances smoldering emissions were sampled.

During this same time period, the Chena Lakes (F-unit) prescribed fire occurred. Eighteen forest floor consumption plots were established and measured. Forty forest floor moisture content samples were collected before ignition. Two towers were positioned near the consumption plots and measured flaming and smoldering emissions. In addition, smoldering sampling occurred several days following the ignition.

In August, the Black Hills wildfire (B400) located on the Tetlin Wildlife Refuge near Tok, Alaska became very active. We established one set of eighteen forest floor consumption plots on the northeast corner of the fire. Fuel moisture content samples were collected. Several days later the area burned over and the forest floor consumption plots were re-measured.

Results

The fuel moisture and forest floor consumption results have been reduced and are presented in figure 1. The emission sampling data is still being processed and the forest floor plugs are currently being burned and sampled at the Missoula Fire Lab.

Kenai Peninsula

Two sets of forest floor consumption plots were established at the Mystery creek block 3 prescribed burn site on the Kenai Wildlife. The weather conditions did not allow for the prescribed fire to occur, however, our plots have been established and it will be a minimal effort to refresh the plots for burning next year.

Year 2004

In 2004 we would like to locate a site where very small plots (1 acre or less could be burned under different moisture conditions to determine the consumption and fuel moisture relationship and flammability limits. A weather station would be positioned at the site with moisture probes and a sampling protocol for collecting weekly moisture samples. In addition, a liaison/escort hired by AFS will coordinate prescribed fire and wildfire opportunities for the study, order resources, obtain permission to enter the fire zone, and escort the crew into the area.

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Unit	Date Burned	Mean Live Moss Moisture	Dead Moss Moisture	Upper Duff Moisture	Lower Duff Moisture	Preburn Forest Floor Depth	Forest Floor Reduction
		%	%	%	%	(in)	(in)
Erickson Creek 1A	06/21/2003	21	62	155	262	8.9	2.4
Erickson Creek 1B	06/22/2003	16	70	167	255	9.5	4.9
Erickson Creek 1C	No burn	104	86	114	214	No Burn	No Burn
Erickson Creek 1D	06/30/2003	18	46	141	274	9.3	2.2
Erickson Creek 1E	07/01/2003	20	100	236	298	8.8	1.6
Chena Lakes (Rx)		69	87	130	270	10.8	2.3
Black Hills	08/07/2003	69	100	106	199	7.2	4.9

Figure 1. Sampled wildfire and prescribed fire sites with site average fuel moisture contents, forest floor depths, and forest floor reduction.



Figure 2. Moisture sample plug. Note ice layer at the lower right side of plug.



Figure 3. Flaming front passing through forest floor consumption plots on the Erickson Creek wildfire.



Figure 4. measuring forest floor consumption on the Erickson Creek wildfire.



Figure 5. Smoke sampling tower positioned near the forest floor consumption plots on the F-unit prescribed burn at Chena lakes.